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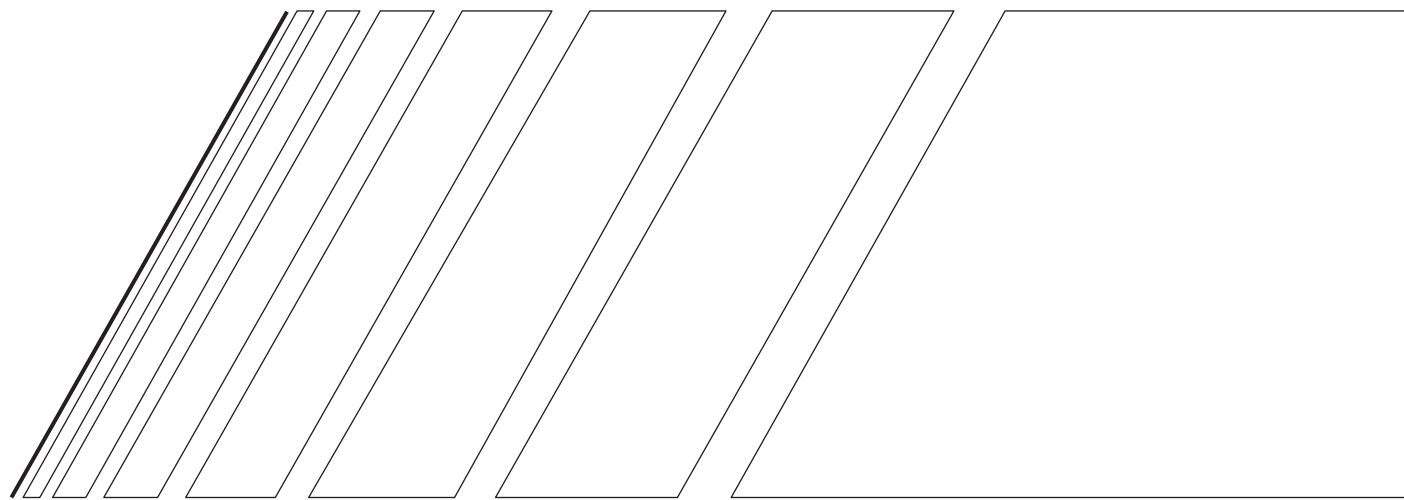
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# **USER'S MANUAL**

# **SMARTSTEP A** SERIES

MODELS R7M-A□ (Servomotors)  
R7D-AP□ (Servo Drivers)

**Servomotors/Servo Drivers**

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Thank you for choosing this SMARTSTEP A-series product. Proper use and handling of the product will ensure proper product performance, will lengthen product life, and may prevent possible accidents.

Please read this manual thoroughly and handle and operate the product with care. Please keep this manual handy for reference after reading it.

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1. To ensure safe and proper use of the OMRON Inverters, please read this USER'S MANUAL (Cat. No. I533-E1) to gain sufficient knowledge of the devices, safety information, and precautions before actual use.
2. The products are illustrated without covers and shieldings for closer look in this USER'S MANUAL. For actual use of the products, make sure to use the covers and shieldings as specified.
3. This USER'S MANUAL and other related user's manuals are to be delivered to the actual end users of the products.
4. Please keep this manual close at hand for future reference.
5. If the product has been left unused for a long time, please inquire at our sales representative.

## **NOTICE**

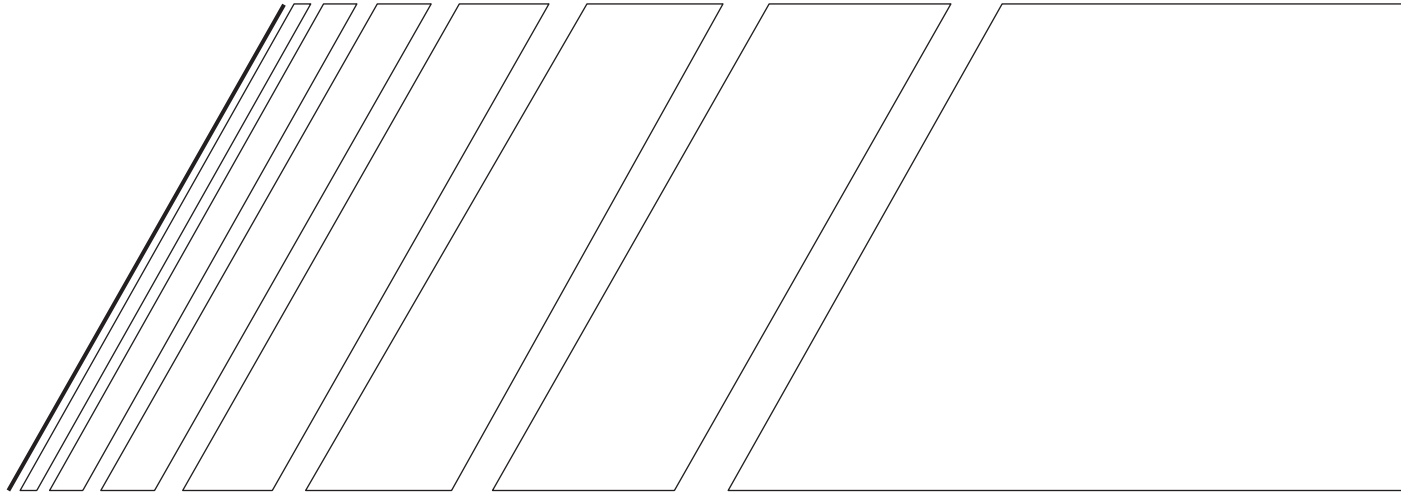
1. This manual describes information about installation, wiring, switch setting, and troubleshooting of the SMARTSTEP A-series Servomotors and Servo Drivers. For information about actual operating procedures using a Parameter Unit, refer to the *SMARTSTEP A Series Operation Manual (I534)*.
2. Be sure that this manual accompanies the product to its final user.
3. Although care has been given in documenting the product, please contact your OMRON representative if you have any suggestions on improving this manual.
4. Assume that anything not specifically described in this manual is not possible.
5. Do not allow the Servomotor or Servo Driver to be wired, set, or operated (from a Parameter Unit) by anyone that is not a profession electrical engineer or the equivalent.
6. We recommend that you add the following precautions to any instruction manuals you prepare for the system into which the product is being installed.
  - Precautions on the dangers of high-voltage equipment.
  - Precautions on touching the terminals of the product even after power has been turned OFF. (These terminals are live even with the power turned OFF.)
7. Specifications and functions may be changed without notice in order to improve product performance.
8. Positive and negative rotation of AC Servomotors described in this manual are defined as looking at the end of the output shaft of the motor as follows: Counterclockwise rotation is positive and clockwise rotation is negative.
9. Do not perform withstand-voltage or other megameter tests on the product. Doing so may damage internal components.
10. Servomotors and Servo Drivers have a finite service life. Be sure to keep replacement products on hand and to consider the operating environment and other conditions affecting the service life.
11. Do not set values for any parameters not described in this manual. Operating errors may result. Consult your OMRON representative if you have questions.
12. Before using the product under conditions which are not described in the manual or applying the product to nuclear control systems, railroad systems, aviation systems, vehicles, combustion systems, medical equipment, amusement machines, safety equipment, and other systems, machines, and equipment that may have a serious influence on lives and property if used improperly, consult your OMRON representative.

## **Items to Check Before Unpacking**

1. Check the following items before removing the product from the package:
  - Has the correct product been delivered (i.e., the correct model number and specifications)?
  - Has the product been damaged in shipping?
2. Check that the following accessories have been delivered.
  - Safety Precautions

No connectors or mounting screws are provided. Obtain these separately.

**OMRON**



# **USER'S MANUAL**

# **SMARTSTEP A** SERIES

MODELS R7M-A□ (Servomotors)

R7D-AP□ (Servo Drivers)


**Servomotors/Servo Drivers**





## **Notice:**

OMRON products are manufactured for use according to proper procedures by a qualified operator and only for the purposes described in this manual.

The following conventions are used to indicate and classify precautions in this manual. Always heed the information provided with them. Failure to heed precautions can result in injury to people or damage to property.

 **DANGER** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. Additionally, there may be severe property damage.

 **WARNING** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. Additionally, there may be severe property damage.

 **Caution** Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.

## **OMRON Product References**

All OMRON products are capitalized in this manual. The word “Unit” is also capitalized when it refers to an OMRON product, regardless of whether or not it appears in the proper name of the product.

The abbreviation “Ch,” which appears in some displays and on some OMRON products, often means “word” and is abbreviated “Wd” in documentation in this sense.

The abbreviation “PC” means Programmable Controller and is not used as an abbreviation for anything else.

## **Visual Aids**

The following headings appear in the left column of the manual to help you locate different types of information.

**Note** Indicates information of particular interest for efficient and convenient operation of the product.

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No patent liability is assumed with respect to the use of the information contained herein. Moreover, because OMRON is constantly striving to improve its high-quality products, the information contained in this manual is subject to change without notice. Every precaution has been taken in the preparation of this manual. Nevertheless, OMRON assumes no responsibility for errors or omissions. Neither is any liability assumed for damages resulting from the use of the information contained in this publication.















## General Warnings

Observe the following warnings when using the SMARTSTEP Servomotor and Servo Driver and all connected or peripheral devices.

This manual may include illustrations of the product with protective covers removed in order to describe the components of the product in detail. Make sure that these protective covers are on the product before use.

Consult your OMRON representative when using the product after a long period of storage.

-  **WARNING** Always connect the frame ground terminals of the Servo Driver and the Servomotor to a class-3 ground (to 100  $\Omega$  or less). Not connecting to a class-3 ground may result in electric shock.
-  **WARNING** Do not touch the inside of the Servo Driver. Doing so may result in electric shock.
-  **WARNING** Do not remove the front cover, terminal covers, cables, or optional items while the power is being supplied. Doing so may result in electric shock.
-  **WARNING** Installation, operation, maintenance, or inspection must be performed by authorized personnel. Not doing so may result in electric shock or injury.
-  **WARNING** Wiring or inspection must not be performed for at least five minutes after turning OFF the power supply. Doing so may result in electric shock.
-  **WARNING** Do not damage, press, or put excessive stress or heavy objects on the cables. Doing so may result in electric shock.
-  **WARNING** Do not touch the rotating parts of the Servomotor in operation. Doing so may result in injury.
-  **WARNING** Do not modify the product. Doing so may result in injury or damage to the product.
-  **WARNING** Provide a stopping mechanism on the machine to ensure safety. The holding brake is not designed as a stopping mechanism for safety purposes.
-  **WARNING** Provide an external emergency stopping mechanism that can stop operation and shutting off the power supply immediately. Not doing so may result in injury.
-  **WARNING** Do not come close to the machine immediately after resetting momentary power interruption to avoid an unexpected restart. (Take appropriate measures to secure safety against an unexpected restart.) Doing so may result in injury.
-  **Caution** Use the Servomotors and Servo Drivers in a specified combination. Using them incorrectly may result in fire or damage to the products.



**⚠ Caution** Do not store or install the product in the following places. Doing so may result in fire, electric shock, or damage to the product.

- Locations subject to direct sunlight.
- Locations subject to temperatures or humidity outside the range specified in the specifications.
- Locations subject to condensation as the result of severe changes in temperature.
- Locations subject to corrosive or flammable gases.
- Locations subject to dust (especially iron dust) or salts.
- Locations subject to shock or vibration.
- Locations subject to exposure to water, oil, or chemicals.

**⚠ Caution** Do not touch the Servo Driver radiator, Servo Driver regeneration resistor, or Servomotor while the power is being supplied or soon after the power is turned OFF. Doing so may result in a skin burn due to the hot surface.

## ***Storage and Transportation Precautions***

**⚠ Caution** Do not hold the product by the cables or motor shaft while transporting it. Doing so may result in injury or malfunction.

**⚠ Caution** Do not place any load exceeding the figure indicated on the product. Doing so may result in injury or malfunction.

## ***Installation and Wiring Precautions***

**⚠ Caution** Do not step on or place a heavy object on the product. Doing so may result in injury.







**⚠ Caution** Do not cover the inlet or outlet ports and prevent any foreign objects from entering the product. Doing so may result in fire.

**⚠ Caution** Be sure to install the product in the correct direction. Not doing so may result in malfunction.







**⚠ Caution** Provide the specified clearances between the Servo Driver and the control panel or with other devices. Not doing so may result in fire or malfunction.

**⚠ Caution** Do not apply any strong impact. Doing so may result in malfunction.


**⚠ Caution** Be sure to wire correctly and securely. Not doing so may result in motor runaway, injury, or malfunction.


-  **Caution** Be sure that all the mounting screws, terminal screws, and cable connector screws are tightened to the torque specified in the relevant manuals. Incorrect tightening torque may result in malfunction.
-  **Caution** Use crimp terminals for wiring. Do not connect bare stranded wires directly to terminals. Connection of bare stranded wires may result in burning.
-  **Caution** Always use the power supply voltage specified in the User's Manual. An incorrect voltage may result in malfunction or burning.
-  **Caution** Take appropriate measures to ensure that the specified power with the rated voltage and frequency is supplied. Be particularly careful in places where the power supply is unstable. An incorrect power supply may result in malfunction.
-  **Caution** Install external breakers and take other safety measures against short-circuiting in external wiring. Insufficient safety measures against short-circuiting may result in burning.
-  **Caution** Take appropriate and sufficient countermeasures when installing systems in the following locations. Failure to do so may result in damage to the product.
- Locations subject to static electricity or other forms of noise.
  - Locations subject to strong electromagnetic fields and magnetic fields.
  - Locations subject to possible exposure to radioactivity.
  - Locations close to power supplies.

## ***Operation and Adjustment Precautions***

-  **Caution** Confirm that no adverse effects will occur in the system before performing the test operation. Not doing so may result in equipment damage.
-  **Caution** Check the newly set parameters and switches for proper execution before actually running them. Not doing so may result in equipment damage.
-  **Caution** Do not make any extreme adjustments or setting changes. Doing so may result in unstable operation and injury.
-  **Caution** Separate the Servomotor from the machine, check for proper operation, and then connect to the machine. Not doing so may cause injury.
-  **Caution** When an alarm occurs, remove the cause, reset the alarm after confirming safety, and then resume operation. Not doing so may result in injury.
-  **Caution** Do not use the built-in brake of the Servomotor for ordinary braking. Doing so may result in malfunction.

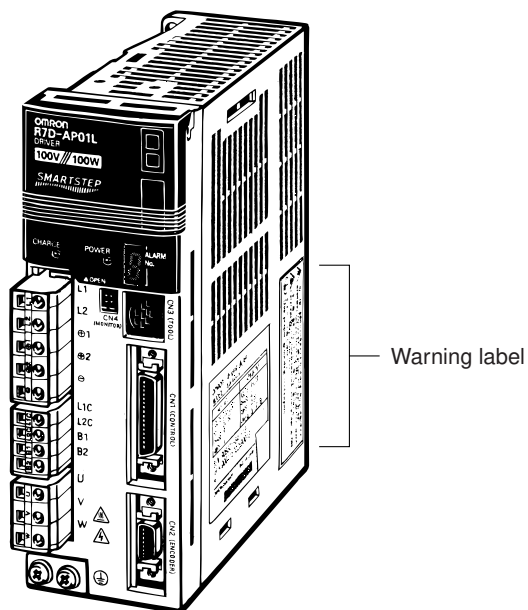
## ***Maintenance and Inspection Precautions***

 **WARNING** Do not attempt to disassemble, repair, or modify any Units. Any attempt to do so may result in malfunction, fire, or electric shock.

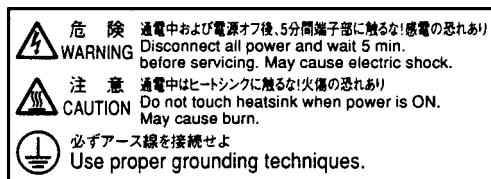
 **Caution** Resume operation only after transferring to the new Unit the contents of the data required for operation. Not doing so may result in an unexpected operation.

## Warning Labels

Warning labels are pasted on the product as shown in the following illustration. Be sure to follow the instructions given there.



Example from R7D-AP01L



Example from R7D-AP01L



## ***Read and Understand this Manual***

Please read and understand this manual before using the product. Please consult your OMRON representative if you have any questions or comments.

## ***Warranty and Limitations of Liability***

### ***WARRANTY***

OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON.

OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, REGARDING NON-INFRINGEMENT, MERCHANTABILITY, OR FITNESS FOR PARTICULAR PURPOSE OF THE PRODUCTS. ANY BUYER OR USER ACKNOWLEDGES THAT THE BUYER OR USER ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. OMRON DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED.

### ***LIMITATIONS OF LIABILITY***

OMRON SHALL NOT BE RESPONSIBLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY.

In no event shall the responsibility of OMRON for any act exceed the individual price of the product on which liability is asserted.

IN NO EVENT SHALL OMRON BE RESPONSIBLE FOR WARRANTY, REPAIR, OR OTHER CLAIMS REGARDING THE PRODUCTS UNLESS OMRON'S ANALYSIS CONFIRMS THAT THE PRODUCTS WERE PROPERLY HANDLED, STORED, INSTALLED, AND MAINTAINED AND NOT SUBJECT TO CONTAMINATION, ABUSE, MISUSE, OR INAPPROPRIATE MODIFICATION OR REPAIR.

# ***Application Considerations***

## ***SUITABILITY FOR USE***

OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the products.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this manual.
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
- Systems, machines, and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.

**NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCTS ARE PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.**

## ***PROGRAMMABLE PRODUCTS***

OMRON shall not be responsible for the user's programming of a programmable product, or any consequence thereof.

# **Disclaimers**

## ***CHANGE IN SPECIFICATIONS***

Product specifications and accessories may be changed at any time based on improvements and other reasons.

It is our practice to change model numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the products may be changed without any notice. When in doubt, special model numbers may be assigned to fix or establish key specifications for your application on your request. Please consult with your OMRON representative at any time to confirm actual specifications of purchased products.

## ***DIMENSIONS AND WEIGHTS***

Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

## ***PERFORMANCE DATA***

Performance data given in this manual is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of OMRON's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the OMRON Warranty and Limitations of Liability.

## ***ERRORS AND OMISSIONS***

The information in this manual has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical, or proofreading errors, or omissions.



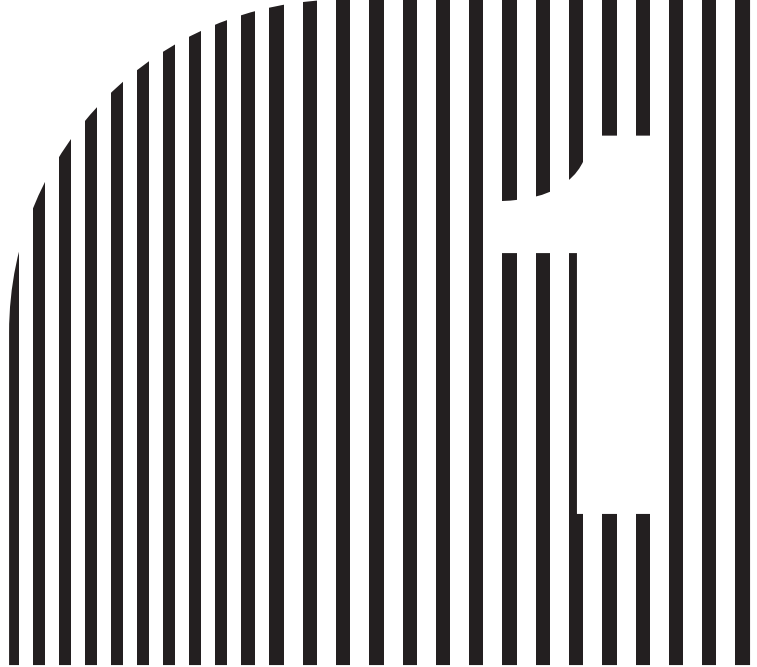


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# Chapter 1

## Introduction

- 1-1 Features
- 1-2 System Configuration
- 1-3 Servo Driver Nomenclature
- 1-4 Applicable Standards
- 1-5 System Block Diagrams

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## 1-1 Features

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The SMARTSTEP A-series Servomotors and Servo Drivers have been developed as pulse string input-type Position Controllers to replace stepping motors in simple positioning systems. The SMARTSTEP A-series Servomotors and Servo Drivers combine the stepping motor's ease of use with faster positioning resulting from high speed and high torque, higher reliability with no loss of positioning accuracy even during sudden load changes, and other advanced features.

### ■ Faster Response and Rotation Speed

SMARTSTEP A-series Servomotors and Servo Drivers incorporate the same high-speed and high-torque features, unachievable with stepping motors, as the OMNUC W Series. The SMARTSTEP A-series Servomotors provide faster rotation speeds of up to 4,500 r/min, with constant operation possible at this speed. Faster output torque of up to 1 s can output up to approximately 300% of the rated torque, providing even faster middle- and long-stroke positioning.

### ■ Constant Accuracy

The A-series product line's higher encoder resolution of 2,000 pulses/rotation provides feedback control enabling continuous operation without loss of positioning accuracy, even with sudden load changes or sudden acceleration or deceleration.

### ■ Minimal Setting with Servo Driver Front Panel Switches

The SMARTSTEP A Series can be operated immediately without time-consuming parameter setting. The A-series Servo Drivers' front panel switches enable easier alteration of function or positioning resolution settings.

#### ● Resolution Settings

SMARTSTEP A-series Servomotor resolution can be selected from the following four levels: 500 pulses/rotation ( $0.72^\circ/\text{step}$ ); 1,000 pulses/rotation ( $0.36^\circ/\text{step}$ ) (default setting); 5,000 pulses/rotation ( $0.072^\circ/\text{step}$ ); or 10,000 pulses/rotation ( $0.036^\circ/\text{step}$ )

#### ● Command Pulse Input Setting

SMARTSTEP A-series command pulse input setting can be switched between CW/CCW (2-pulse) and SIGN/PULS (single-pulse) methods to easily adapt to Position Controller output specifications.

#### ● Dynamic Brake Setting

SMARTSTEP A-series Servomotors can be forcibly decelerated to a stop at RUN OFF or when an alarm occurs.

#### ● Gain Setting

A special rotary switch on SMARTSTEP A-series Servo Drivers enables easy gain setting. Online autotuning can also be activated with the flick of a switch, and responsiveness can be easily matched to the machinery to be used.

**Note** Using a Parameter Unit or personal computer enables operation with parameter settings.

### ■ **Cylinder-style and Flat-style Servomotors**

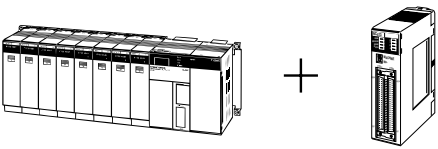
The SMARTSTEP A Series offers Flanged Cylinder-style Servomotors, with a smaller mounting area, and Flat-style Servomotors, with a shorter overall length. The Flat Servomotor depth dimensions are approximately the same as those of stepping motors of the same output capacity. Servomotors can be selected by size, thereby making equipment more compact.

### ■ **A Wider Selection of Programming Devices**

Special SMARTSTEP A-series Parameter Units and personal computer monitoring software are available. The special monitoring software enables performing parameter setting, speed and current monitoring, speed and current waveform displays, I/O monitoring, autotuning, jogging, and other operations from a computer. It is also possible to perform multiple-axis communications that set the parameters and monitor operations for multiple Servo Drivers. For details, refer to the *Servo Driver Personal Computer Monitor Software (CD-ROM) for Windows 95/98, Version 2.0 (WMON Win Ver.2.0)* (Catalog No.: SBCE-011).

# 1-2 System Configuration

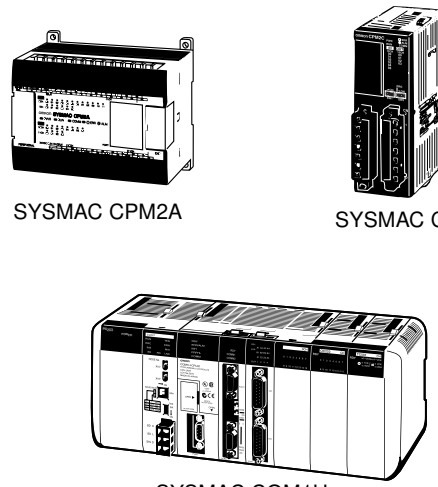
**SYSMAC + Position Control Unit with pulse string output**



SYSMAC CJ/CS/CV Programmable Controller

Position Control Units  
 CJ1W-NC113/213/413  
 CJ1W-NC133/233/433  
 CS1W-NC113/213/413  
 CS1W-NC133/233/433  
 C200HW-NC113/213/413  
 C500-NC113/211

**SYSMAC Programmable Controllers with pulse outputs**

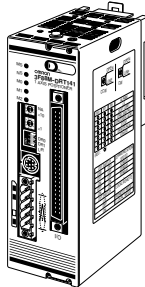


SYSMAC CPM2A

SYSMAC CPM2C

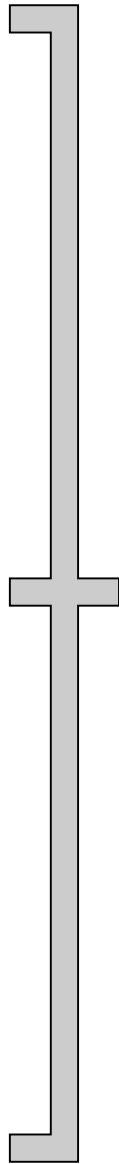
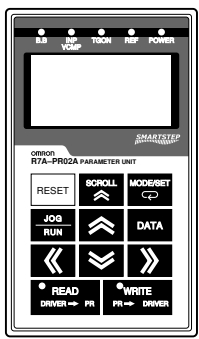
SYSMAC CQM1H

**Single-shaft Positioner with pulse string output**

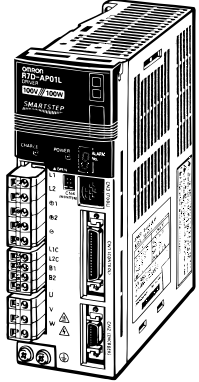


3F88M-DRT141 Single-shaft Positioner for DeviceNet

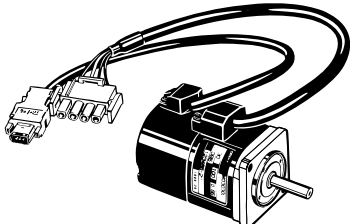
Pulse String

R7A-PR02A Parameter Unit (Hand-held)

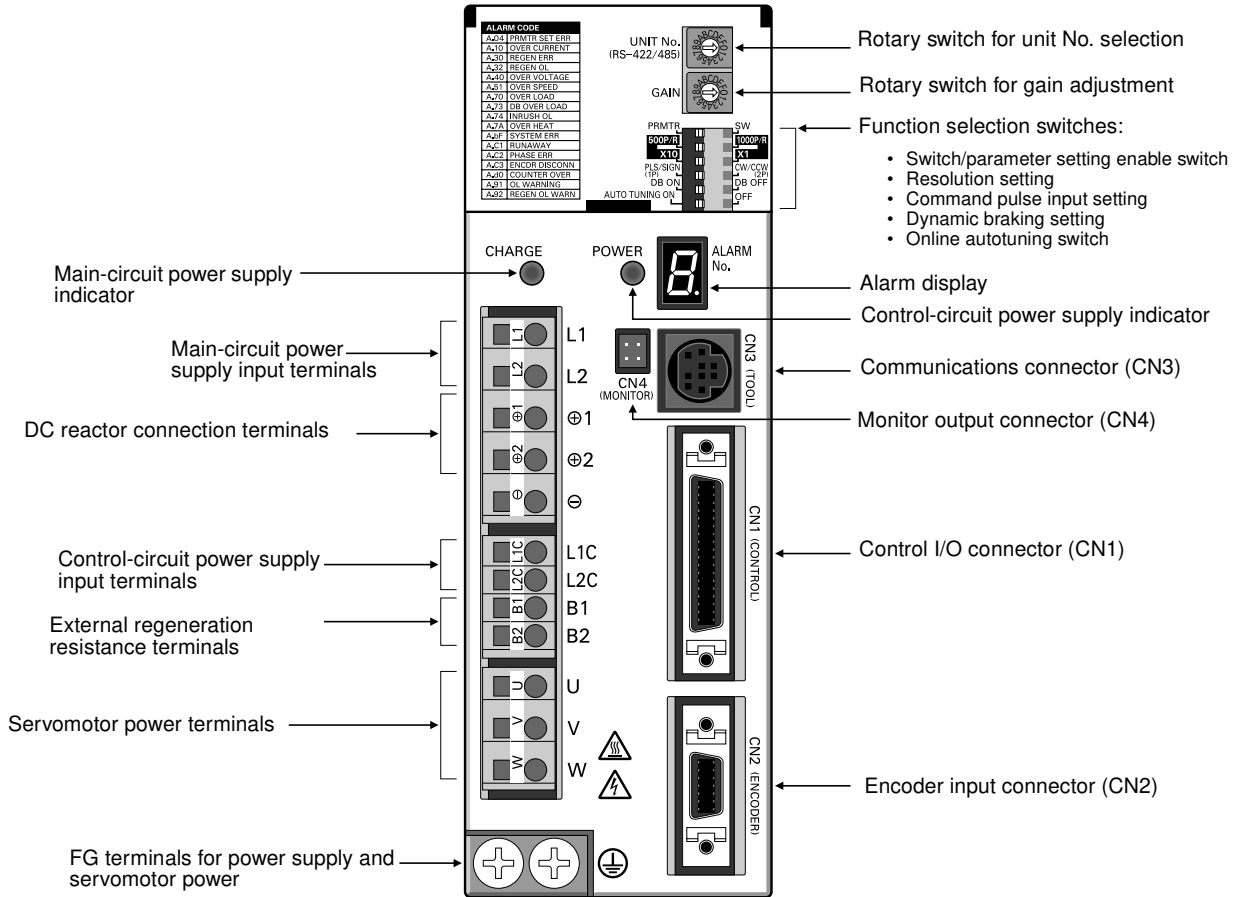


SMARTSTEP A-series R7D-AP Servo Driver



SMARTSTEP A-series R7M-A Servomotor

### 1-3 Servo Driver Nomenclature





## 1-4 Applicable Standards

### ■ EC Directives

EC Directives	Product	Applicable standards	Remarks
Low Voltage Directive	AC Servo Drivers	EN50178	Safety requirements for electrical devices for measurement, control, and research facilities
	AC Servomotors	IEC60034-1, -5, -8, -9 EN60034-1, -9	Rotating electrical equipment
EMC Directives	AC Servo Drivers and AC Servomotors	EN55011 class A group 1	Wireless interference and measurement methods for radio-frequency devices for industry, science, and medical application
		EN61000-6-2	Electromagnetic compatibility and immunity standards for industrial environments

**Note** Installation under the conditions stipulated in *3-2-5 EMC-compatible Wiring* must be met to ensure conformance to EMC Directives.

### ■ UL and cUL Standards

Standards	Product	Applicable standards	File No.	Remarks
UL	AC Servo Drivers	UL508C	E179149	Power conversion devices
	AC Servomotors	UL1004	E179189	Electric motors
cUL	AC Servo Drivers	cUL C22.2 No. 14	E179149	Industrial control devices
	AC Servomotors	cUL C22.2 No. 100	E179189	Motors and generators

# 1-5 System Block Diagrams

## ■ 100 V AC: R7D-APA3L/-APA5L/-AP01L/-AP02L/-AP04L

